

THAT WHICH IS CLAIMED:

1. A method of lining a surface of a substrate, said method comprising:
providing a reactive mixture which comprises (1) a resin containing active hydrogens;
(2) a polycarbodiimide; and (3) an organic diluent;
reacting the resin containing active hydrogens and the polycarbodiimide to chemically
5 bind the resin and the polycarbodiimide;
applying the chemically bound resin and polycarbodiimide to the surface of the
substrate; and
curing the chemically bound resin and polycarbodiimide in the presence of a initiator
to form a cured resin material which lines the surface of the substrate.

2. The method according to Claim 1, wherein the substrate is a conduit.

3. The method according to Claim 1, wherein the reactive mixture comprises
greater than about 5 percent by weight of polycarbodiimide.

4. The method according to Claim 1, wherein the resin containing active
hydrogens is selected from the group consisting of saturated polyester resins, unsaturated
polyester resins, vinyl ester resins, polyurethane resins, and mixtures thereof.

5. The method according to Claim 1, wherein the organic diluent is selected from
the group consisting of toluene, xylene, chlorobenzene, chloroform, tetrahydrofuran, ethyl
acetate, isopropyl acetate, butyl acetate, butyl phthalate, acetone, methyl cellosolve acetate,
cellosolve acetate, butyl cellosolve, methyl ethyl ketone, diethyl ketone, cyclohexanone,
5 styrene, alphas-methylstyrene, p-methyl styrene, divinyl benzene, vinyl toluene, divinyl
toluene, ethyl styrene, tert-butyl styrene, monochloro styrene, dichloro styrene, vinyl
cyclohexane, vinyl cyclopentane, vinyl toluene, vinyl anthracenes, 3-vinyl benzyl chloride, 4-
vinyl biphenyl, 4-vinyl-1-cyclohexene, vinyl cyclooctane, 2-vinyl naphthalene, 5-vinyl-2-

norbornene, 1-vinylimidazole, 2-vinyl pyridine, 4-vinyl pyridine, 1-vinyl-2-pyrrolidinone, 9-
10 vinyl carbazole, ethylene glycol dimethacrylate, butanediol dimethacrylate, hexanediol
dimethacrylate, and mixtures thereof.

6. The method according to Claim 1, wherein the organic diluent comprises a
polyfunctional acrylate component.

7. The method according to Claim 1, wherein the polycarbodiimide is formed
from a reaction between an isocyanate-containing intermediate and a diisocyanate.

8. The method according to Claim 7, wherein the isocyanate-containing
intermediate is formed from a reaction between a component containing active hydrogens and
a diisocyanate.

9. The method according to Claim 8, wherein the component containing active
hydrogens is selected from the group consisting of alcohols, amines, thiols, phenols, silanol, -
P-OH, -P-H, and mixtures thereof.

10. The method according to Claim 8, wherein the component containing active
hydrogens is an alcohol.

11. The method according to Claim 1, wherein the initiator is an organic
peroxide selected from the group consisting of cumene hydroperoxide; methyl ethyl ketone
peroxide; benzoyl peroxide; acetyl peroxide; 2,5-dimethylhexane-2,5-dihydroperoxide; tert-
butyl peroxybenzoate; di-tert-butyl perphthalate; dicumyl peroxide; 2,5-dimethyl-2,5-bis(tert-
5 butylperoxide)hexane; 2,5-dimethyl-2,5-bis(tert-butylperoxy)hexyne; bix(tert-
butylperoxyisopropyl)benzene; ditert-butyl peroxide; 1,1-di(tert-amylperoxy)-cyclohexane;
1,1-di-(tert-butylperoxy)-3,3,5-trimethylcyclohexane; 1,1-di-(tert-butylperoxy)-cyclohexane;
2,2-di-(tert-butylperoxy)butane; n-butyl-4,4-di(tert-butylperoxy)valerate; ethyl-3,3-di-(tert-

10 amylperoxy)butyrate; ethyl-3,3-di(tert-butylperoxy)-butyrate; t-butyl peroxy-neodecanoate;
di-(4-5-butyl-cyclohexyl)-peroxydicarbonate; lauryl peroxyde; 2,5-dimethyl-2,5-bis(2-ethyl-
hexanoyl peroxy) hexane; t-amyl peroxy-2-ethylhexanoate; 2,2'-azobis(2-methyl-
propionitrile); 2,2'-azobis(2,4-methylbutanenitrile); and mixtures thereof.

12. The method according to Claim 1, wherein the initiator is a photoinitiator.

13. The method according to Claim 1, wherein said curing step is carried out in
the presence of a promoter.

14. The method according to Claim 1, wherein said reactive mixture
further comprises fibrous reinforcement material.

15. The method according to Claim 14, wherein the fibrous reinforcement material
is selected from the group consisting of fiberglass, polyester, carbon, metal, organic fibers,
and mixtures thereof.

16. The method according to Claim 1, wherein said reacting step is carried out at a
temperature ranging from about 5°C to about 60°C.

17. The method according to Claim 1, wherein said curing step is carried out at a
temperature ranging from about 40°C to about 150°C.

18. A method of lining a surface of a conduit comprising:
providing a reactive mixture which comprises (1) a resin containing active hydrogens;
(2) a polycarbodiimide; and (3) an organic diluent;
inserting the reactive mixture into a tube, the tube being defined by an inner
5 membrane and an outer membrane;

reacting the resin containing active hydrogens and the polycarbodiimide to chemically bind the resin and the polycarbodiimide;

inserting the tube into a conduit having an inner surface;

applying pressure to the tube such that the tube comes in contact with the inner
10 surface of the conduit; and

curing the chemically bound resin and polycarbodiimide in the presence of an initiator to form a cured resin material which lines the surface of the conduit.

19. The method according to Claim 18, wherein the reactive mixture comprises greater than about 5 percent by weight of polycarbodiimide.

20. The method according to Claim 18, wherein the resin containing active hydrogens is selected from the group consisting of saturated polyester resins, unsaturated polyester resins, vinyl ester resins, polyurethane resins, and mixtures thereof.

21. The method according to Claim 18, wherein the organic diluent is selected from the group consisting of toluene, xylene, chlorobenzene, chloroform, tetrahydrofuran, ethyl acetate, isopropyl acetate, butyl acetate, butyl phthalate, acetone, methyl cellosolve acetate, cellosolve acetate, butyl cellosolve, methyl ethyl ketone, diethyl ketone,
5 cyclohexanone, styrene, alphas-methylstyrene, p-methyl styrene, divinyl benzene, vinyl toluene, divinyl toluene, ethyl styrene, tert-butyl styrene, monochloro styrene, dichloro styrene, vinyl cyclohexane, vinyl cyclopentane, vinyl toluene, vinyl anthracenes, 3-vinyl benzyl chloride, 4-vinyl biphenyl, 4-vinyl-1-cyclohexene, vinyl cyclooctane, 2-vinyl naphthalene, 5-vinyl-2-norbornene, 1-vinylimidazole, 2-vinyl pyridine, 4-vinyl pyridine, 1-
10 vinyl-2-pyrrolidinone, 9-vinyl carbazole, ethylene glycol, dimethacrylate, butanediol dimethacrylate, hexanediol dimethacrylate, and mixtures thereof.

22. The method according to Claim 18, wherein the organic diluent comprises a

polyfunctional acrylate component.

23. The method according to Claim 18, wherein the polycarbodiimide is formed from a reaction between an isocyanate-containing intermediate and a diisocyanate.

24. The method according to Claim 23, wherein the isocyanate-containing intermediate is formed from a reaction between a component containing active hydrogens and a diisocyanate.

25. The method according to Claim 24, wherein the component containing active hydrogens is selected from the group consisting of alcohols, amines, thiols, phenols, silanol, -P-OH, -P-H, and mixtures thereof.

26. The method according to Claim 24, wherein the component containing active hydrogens is an alcohol.

27. The method according to Claim 18, wherein the reactive mixture further comprises fibrous reinforcement material.

28. The method according to Claim 27, wherein the fibrous reinforcement material is selected from the group consisting of fiberglass, polyester, carbon, metal, organic fibers, and mixtures thereof.

29. The method according to Claim 18, wherein the initiator is an organic peroxide initiator selected from the group consisting of cumene hydroperoxide; methyl ethyl ketone peroxide; benzoyl peroxide; acetyl peroxide; 2,5-dimethylhexane-2,5-dihydroperoxide; tert-butyl peroxybenzoate; di-tert-butyl perphthalate; dicumyl peroxide; 2,5-dimethyl-2,5-bis(tert-butylperoxide)hexane; 2,5-dimethyl-2,5-bis(tert-butylperoxy)hexyne; bix(tert-butylperoxyisopropyl)benzene; ditert-butyl peroxide; 1,1-

10 di(tert-amylperoxy)-cyclohexane; 1,1-di-(tert-butylperoxy)-3,3,5-trimethylcyclohexane; 1,1-di-(tert-butylperoxy)-cyclohexane; 2,2-di-(tert-butylperoxy)butane; n-butyl-4,4-di(tert-butylperoxy)valerate; ethyl-3,3-di-(tert-amylperoxy)butyrate; ethyl-3,3-di(tert-butylperoxy)-butyrate; t-butyl peroxy-neodecanoate; di-(4-5-butyl-cyclohexyl)-peroxydicarbonate; lauryl peroxyde; 2,5-dimethyl-2,5-bis(2-ethyl-hexanoyl peroxy) hexane; t-amyl peroxy-2-ethylhexanoate; 2,2'-azobis(2-methyl- propionitrile); 2,2'-azobis(2,4-methylbutanenitrile); and mixtures thereof.

30. The method according to Claim 18, wherein the initiator is a photoinitiator.

31. The method according to Claim 18, wherein the reaction mixture further comprises a promoter.

32. The method according to Claim 18, wherein said reacting step is carried out at a temperature ranging from about 5°C to about 60°C.

33. A lined substrate comprising:
a cured resin material comprising a resin chemically bound to a polycarbodiimide; and
a surface of said substrate which contains said cured resin material thereon.

34. The lined substrate according to Claim 33, wherein the resin chemically bound to a polycarbodiimide is selected from the group consisting of saturated polyester resins, unsaturated polyester resins, vinyl ester resins, polyurethane resins, and mixtures thereof.

35. The lined substrate according to Claim 32, wherein said substrate is a conduit.

36. The lined substrate according to Claim 32, wherein said cured resin

material further comprises fibrous reinforcement material selected from the group consisting of fiberglass, polyester, carbon, metal, organic fibers, and mixtures.